Ogden Air Logistics Center

U.S. AIR FORCE

Low Temperature Powder Coating

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Report Documentation Page

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Overview

- **Current wet coating processes present environmental risks**
  - Results in the release of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)
  - Legacy primers contain hexavalent chrome
- **Conventional powder coatings result in an alternative highly durable coating**
  - Results in the release of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)
  - Conventional powders cure at temperatures detrimental to some alloys
- **Low Temperature Cure Powder Coating (LTCPC) is an alternative to conventional powder coating**
  - Cures at < 300 F
  - Still HAP/VOC free
  - Possibly formulated with corrosion inhibitors so chromated primers are not required

Project Team

	Wayne Patterson **OO-ALC 809 MXSS/CLA** **Hill AFB, UT**
	Warren Assink **AFRL** **Wright-Patterson AFB, OH**
	David Piatkowski, Chris Mahendra **NAVAIR**
	James Davila, Chris Geib **SAIC** **Beavercreek, OH**

TECHNICAL APROACH

Demonstration Sites

Validation Phase

- Hill AFB, UT
- NAVAIR Pax River, MD
- CTC, Johnstown, PA
- NASA, Kennedy Space Center, FL

Evaluation Phase

- OO-ALC, Hill AFB, UT
- OC-ALC, Tinker AFB, OK
- WR-ALC, Robins AFB, GA
- NAS Whidbey Island, WA
- FRC Southwest, North Island, CA

Technical Objectives

- **The LTCPC Program was initiated with the following performance objectives:**
  - Demonstrate that LTCPC can show performance comparable to wet paint coatings in laboratory testing
  - Demonstrate that the LTCTC, as applied by trained coating personnel can withstand operational conditions as well as, or better than, wet paint coatings
  - Determine whether the use of LTCPC can result in process and/or environmental cost savings

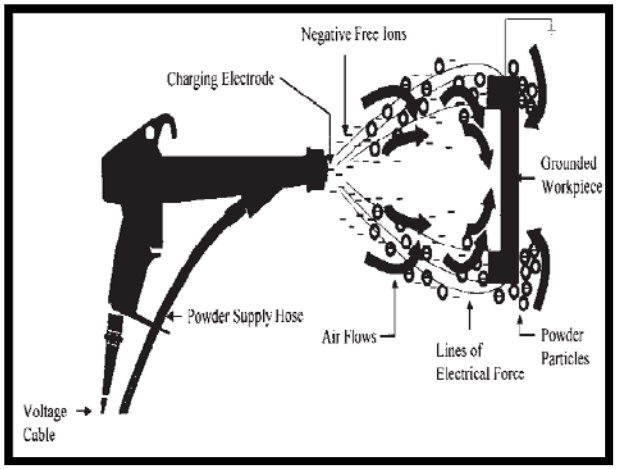
TECHNICAL APROACH

Powder Coating Technology

- Low Temperature Cure Powder Coating
  - Developed under SERDP Project WP-1268
  - Addressed deficiencies of conventional powder coatings
    - High curing temperatures
    - Long-term (>1000hrs) corrosion resistance

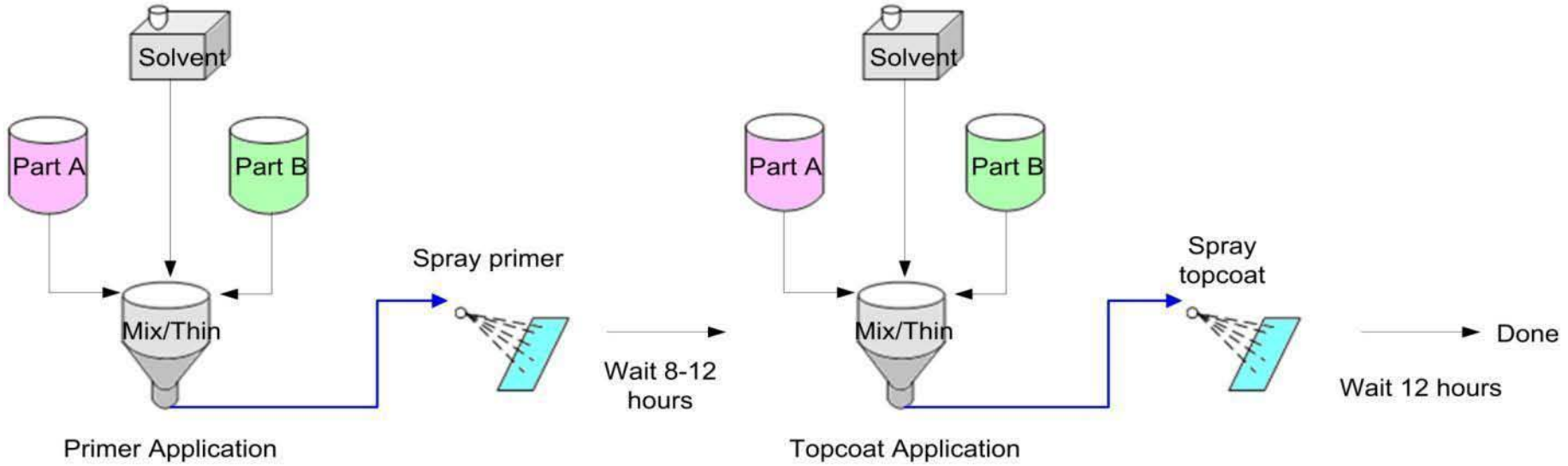
Equipment

- Corona Gun with adjustable voltage
  - Addresses limitation of conventional Corona Guns (Faraday Cage)
  - Improves uniformity of powder coverage within tight corners and recessed areas

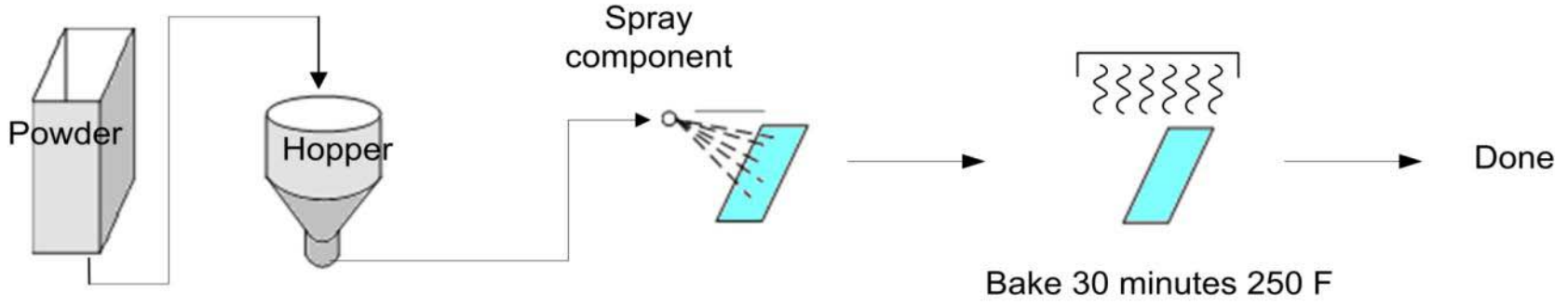


TECHNICAL APROACH

Current Wet Coating Process



Proposed LTCPC



Powder Paint

Pros

- Storage / Shelf Life
- Single Component
- Quick
- Durable
- No VOC
- Transfer Efficiency 95%
- Waste is recyclable

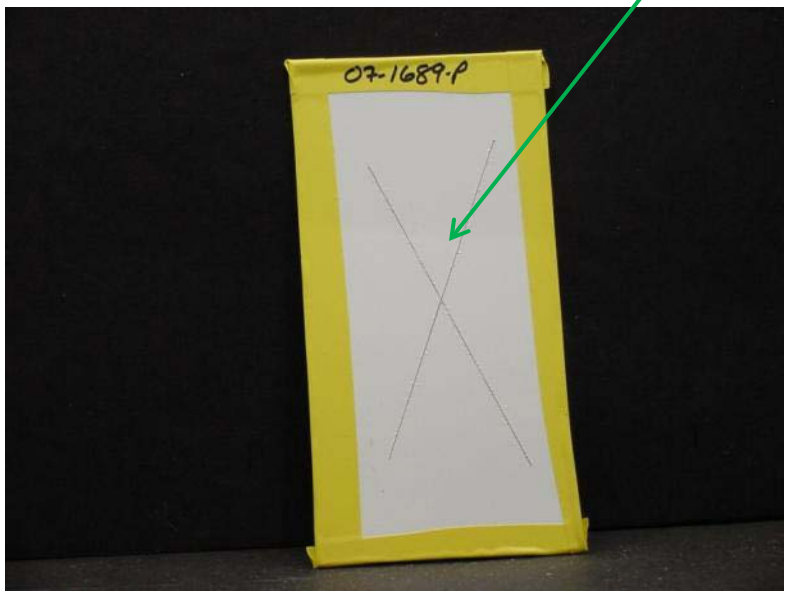
Cons

- Small Parts (limited to booth & oven size)
- Geometries
- Must be cured at Temperature/Time
- Gas or Electric Oven

JTP Results

Filiform Corrosion Resistance

- LTCPC met requirements of MIL-PRF-23377 on two panels
  - Third panel exhibited a single filament extending slightly beyond allowable tolerance



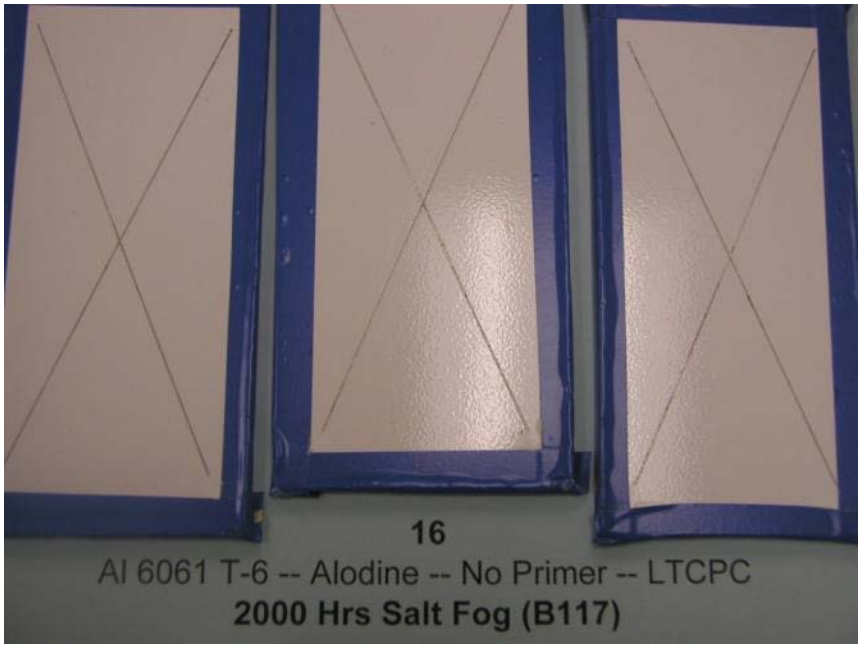
LTCPC on 2024 T-3 Clad

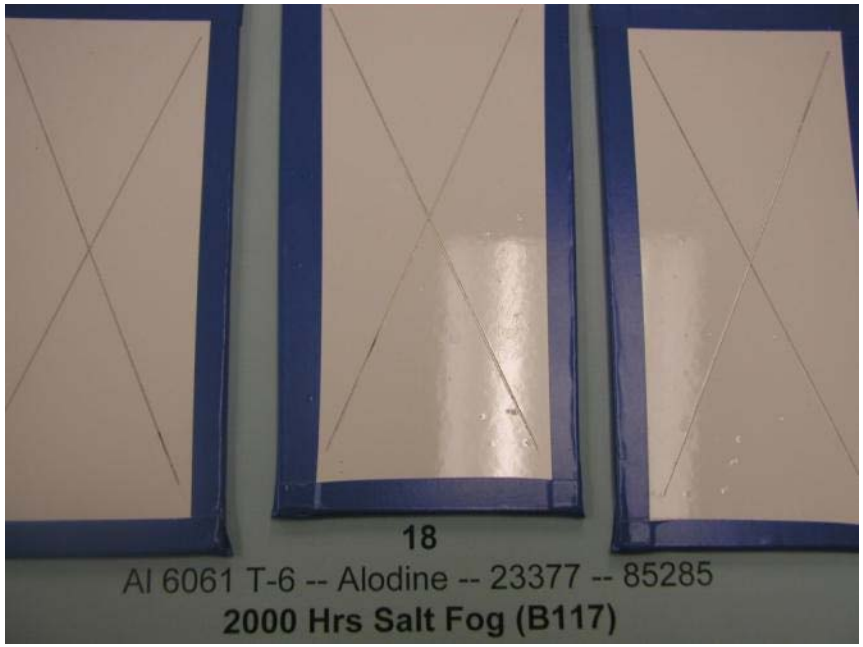
LTCPC on 2024 T-3 Clad

JTP Results

Neutral Salt Spray

- LTCPC performance similar or better than wet coating

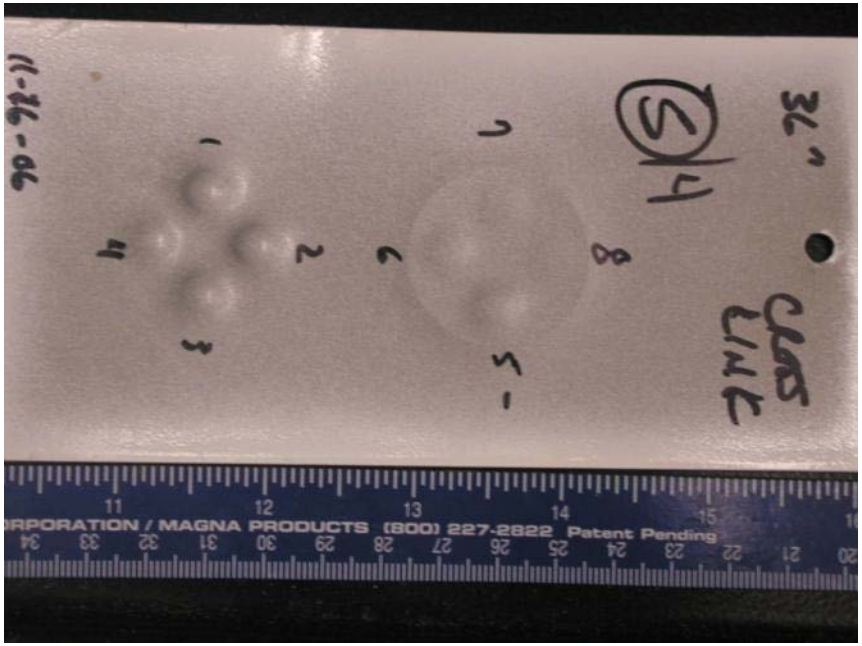




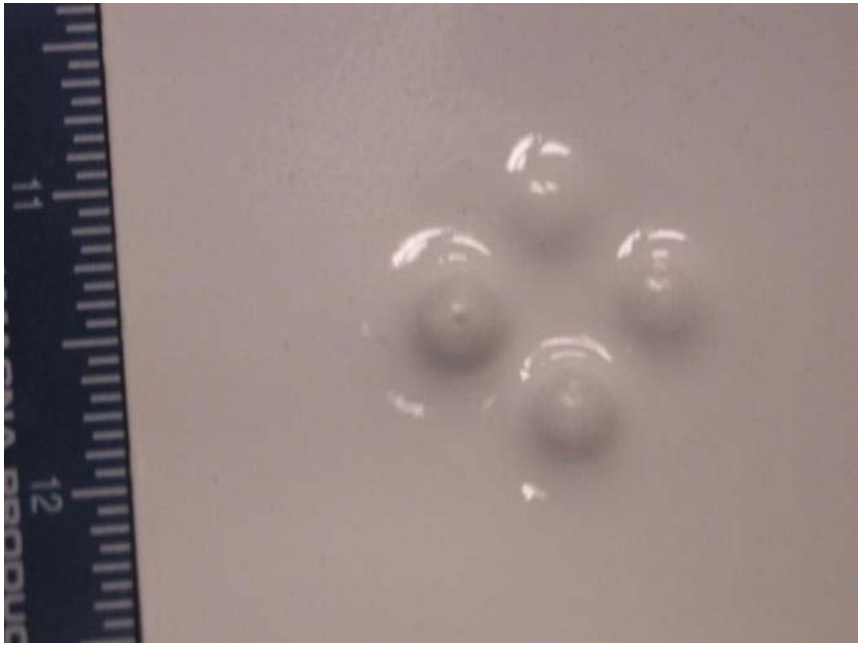
JTP Results

Flexibility / Impact Resistance

- **LTCPC met requirements of MIL-PRF-23377 and MIL-PRF-85285**



Back – LTCPC on 2024, 0 Temper Al

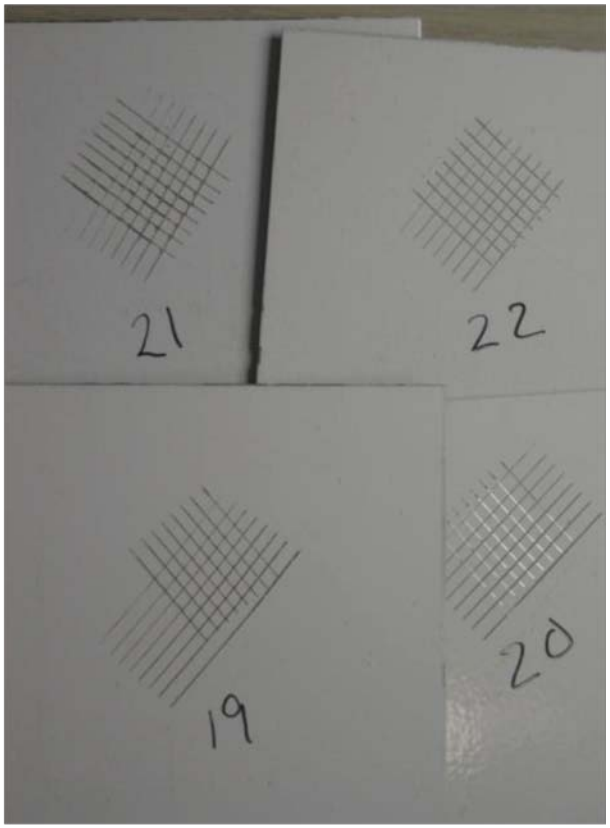


Front – LTCPC on 2024, 0 Temper Al

JTP Results

Adhesion Testing

- **LTCPC with pretreatment passed all adhesion testing**

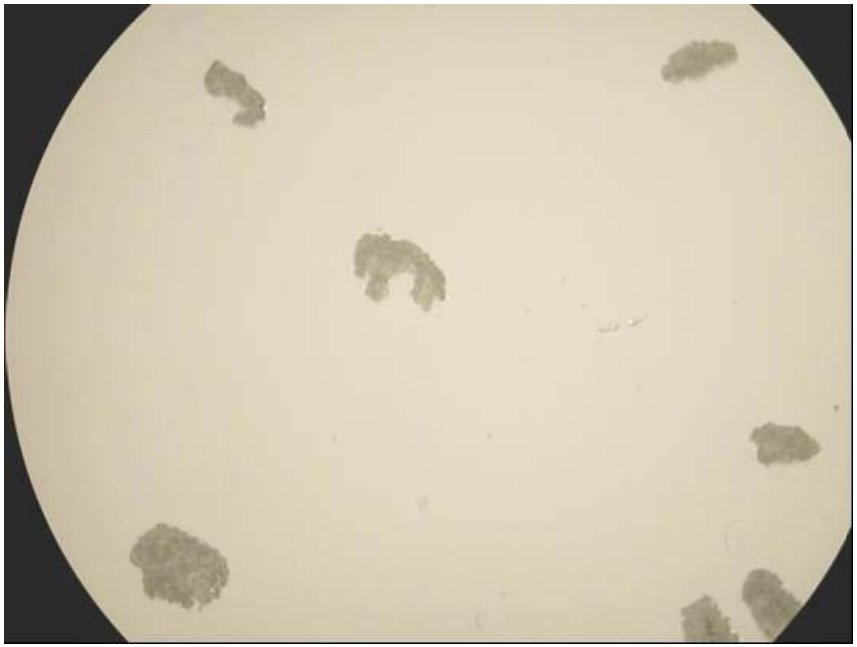


19. MIL-PRF-23377/MIL-PRF-85285 w/DOW 7 Pretreatment
20. LTCPC w/DOW 7 Pretreatment
21. LTCPC w/No Pretreatment (3b adhesion rating)
22. LTCPC w/DOW 7 and Prekote Pretreatment

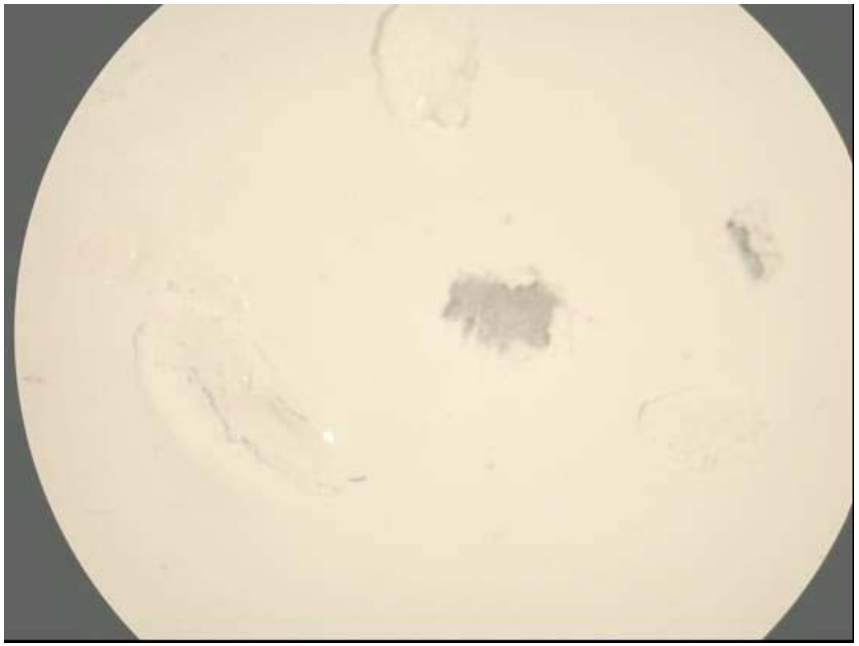
(Magnesium Substrate, AZ31B)

JTP Results

Gravelometer



MIL-PRF-23377/85285



Powder Coat

JTP Results

Summary

WP-0614 LTCPC JTP Test Results

Substrate	Appearance	Salt Spray	SO2	Cyclic	Filiform	Adhesion	Impact	Strip	Immersion	Humidity	Gravel	Low T Flex
4130 steel	SAME	SAME	SAME	SAME	--	SAME	--	Note 3	--	--	--	--
2024-T0 Al	SAME	--	--	--	--	--	Note 2	--	--	--	--	Note 2
2024-T3 Al (CCC)	SAME	SAME	SAME	--	--	--	--	--	Note 2	Note 2	--	--
2024-T3 Al (No)	SAME	LESS	LESS	--	--	--	--	--	Note 2	Note 2	Note 2	--
6060-T6 Al (CCC)	SAME	SAME	SAME	--	--	--	--	--	--	--	--	--
6060-T6 Al (No)	SAME	LESS	LESS	--	--	--	--	--	--	--	--	--
2024-T3 Clad (CCC)	SAME	SAME	--	BETTR	Note 1	--	--	--	--	--	--	--
2024-T3 Clad (No)	SAME	LESS	--	SAME	--	--	--	--	--	--	--	--
6061-T6 Al (CCC)	SAME	BETTR(note 4)	SAME	--	--	SAME	--	Note 3	--	--	--	--
6061-T6 Al (PK)	SAME	BETTR (note 4)	LESS	--	--	SAME	--	Note 3	--	--	--	--
AZ31B Mg (Dow)	SAME	SAME	--	--	--	SAME	--	Note 3	--	--	--	--

Legend: LESS=Less than control SAME=Same as control BETTR=Better than control

Note 1: Two of three LTCPC panels passed. One panel exceeded limit by 1/32 in.
Note 2: Met requirements in the MIL Standards (MIL-PRF-23377, MIL-PRF-85285, MIL-PRF-24712)
Note 3: Non methylene chloride stripper effective.
Note 4: Exceeded 3300 hrs in salt spray


Spray Systems

Demonstration Testing

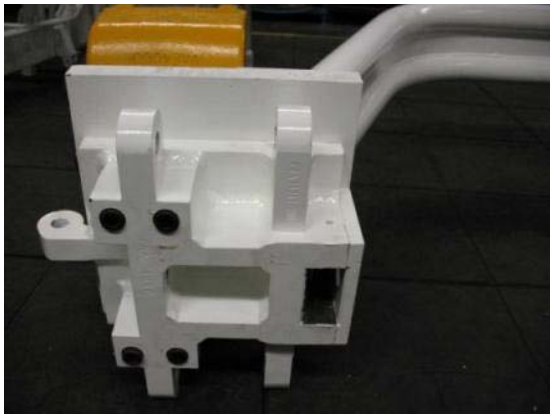
- **USAF & USN Demonstration Sites & Test Articles**
  - **NAS Whidbey Island, WA**
    - **Depot for majority of the LTCPC Navy Demo GSE**
      - **Engine Yokes**
      - **Partial results collected on tow bars, pod cradles, and bomb hoists, but coating was stripped early due to NDE requirements**
  - **NAS North Island, CA**
    - **Maintenance facility for GSE deployed on the USS Ronald Reagan**
      - **Nitrogen Carts**
  - **OO-ALC, Hill AFB, UT**
    - **C-130 forward landing gear doors**
    - **C-130 Throttle Quads**

Results - Demonstration Testing

- Navy Ground Support Equipment Field Service Evaluation – NAN-4 Nitrogen Servicing Cart

Results - Demonstration Testing

- **Navy Ground Support Equipment Field Service Evaluation – J-52 Engine Yoke Adapters**



Results - Demonstration Testing

- Air Force Field Service Evaluation – C-130 Nose Landing Gear Doors (Interior Surfaces)

Chromate CC LTC Powder

C-130 Landing Gear Door

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HILL PDM
FOR REPAIR CONTACT
SMSGT CHRIS COWLEY
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C-130 Throttle Quads

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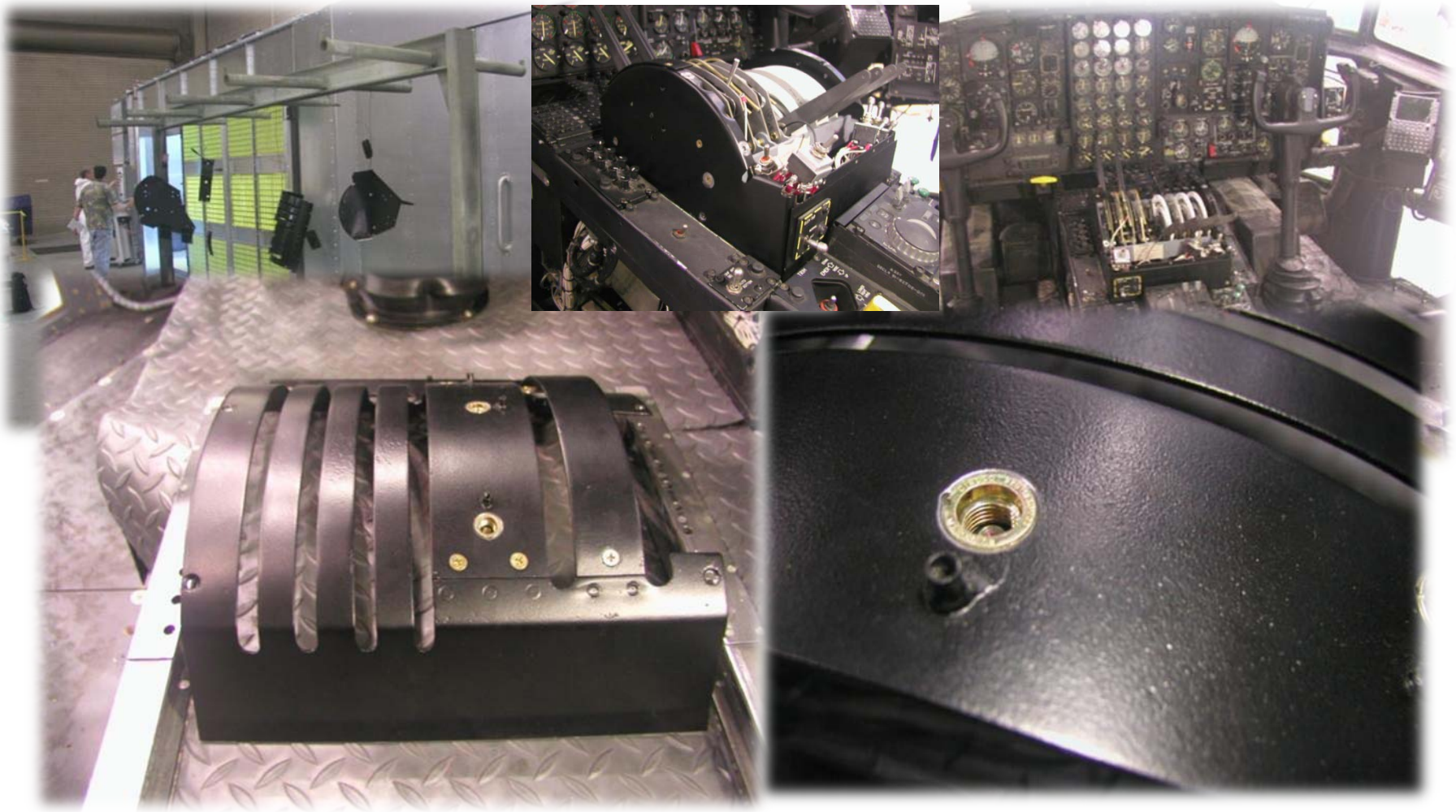

Conclusions and Summary

- Low Temperature Cure Powder Coatings performs comparably to conventional wet coatings both in laboratory and field service evaluations
- LTCPC allows environmental cost reductions through VOC/HAP elimination and hexavalent chrome reduction.
- The LTCPC process greatly shortens the coating operation (LTCPC cures much more rapidly then conventional wet coatings) resulting in labor savings and improved part processing rates.

Conclusions and Summary

- **Powder Coatings are not a total replacement for wet paints…However they are a viable replacement for quite a few back shop processes**
  - **Be observant and cognoscente of processes**
  - **Don't be afraid to try it…Use the Correct Procedure… get authorizations**
  - **Document successes and failures**

- **New Powders are being Developed as Industry *sees the Need and possibilities of use.***

PUBLICATIONS

Geib, C.W., Davila J.A., Patterson W., et al. “Low Temperature Cure Powder Coating, ESTCP Project WP-0614.” Joint Services Environmental Management Conference, Columbus, Ohio. 21 – 24 May 2007.

Geib, C.W., Davila J.A., Patterson W., et al. “Advances and Testing of Powder Coatings for Aerospace Applications, ESTCP Project WP-0614.” SAE AMS Aerospace Organic Coatings Committee (AMS G-8) Fall 2007 Meeting, Long Beach, California. 6 Nov 2007

WP-0614 – Low Temperature Cure Powder Coatings. Poster. The Partners in Environmental Technology Technical Symposium & Workshop. Patterson, W., Davila J.A., et al. Washington, DC. Dec 2007.

Geib, C.W., Davila J.A., Patterson W., et al. “Environmentally Advantaged Powder Coatings for Aerospace Applications.” Third Annual Advanced Aerospace Coating/Decoating Technical Symposium, Orlando, Florida. 9,10 Jan 2008.

Geib, C.W., Davila J.A., Patterson W., et al. “Environmentally Advantaged Powder Coatings for Aerospace Applications, ESTCP Projects WP-0614 & WP-0801.” SERDP/ESTCP Workshop on Surface Finishing and repair Issues for Sustaining New Military Aircraft, Tempe, Arizona. 26-28 Feb 2008.